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Memo Report

From: W. Mark Cummings, P.E.

To: Mr. Eric Michaud; Infiniti

CC: Capt. Chris Pirone; Fire Prevention Division, Portland Fire Department

Subject: **Fire Hazards Assessment of the In'finiti Fermentation & Distillation Site at 250 Commercial St., Portland, ME.**

A review has been conducted of the proposed layout/construction for a new brew pub, with a small distilling operation, which is to be located within a newly renovated space on the 1st floor of a commercial building at 250 Commercial Street in Portland, ME. The purpose of this review was to evaluate the proposed inclusion of a small distillery operation within the brew pub, including the potential fire/explosion hazards that may exist and assess the need to provide adequate fire separation of this operation from the remainder of the brew pub. The end result for this assessment is to develop recommendations to ensure that adequate fire and life safety are provided within the facility.

Background

A new brew pub, *In'finiti Fermentation & Distillation*, is being designed that is to be located within a portion of the 1st floor level of the 3-story building located at 250 Commercial Street in Portland, ME. The brew pub will occupy approximately 5900 ft^2 of the 1st floor. The proposed design for the new brew pub includes a small area, approximately 400 ft^2, which will be used to support distilling operations. The stated plan for the distilling operations is to produce quantities of a number of different alcoholic beverages (spirits). To produce these various beverages, a small still is to be installed in this space, which will be used to distill various liquid mixtures, producing a range of alcoholic beverages with alcoholic contents that will likely range from 40% to 60% by volume. Resulting from discussions with the owner (Mr. Eric Michaud), it was ascertained that a portion of this space will also be used to store some of the finished products, including some that will be stored in small wooden barrels as part of the overall aging process. Those products that will not require the "aging" process will only be stored temporarily, until being shipped to a State-authorized distribution facility. Subsequent to completing the distillation process, the products may be initially stored, temporarily, in one of the six (6) stainless steel holding tanks that are to be located inside the distillation area; each with a capacity of approximately 200 liters (55 gal). When ready for shipping, the product that does not require "aging" will be transferred into individual glass bottles; 750 ml each. These bottles will be packaged into cardboard cases, six (6) bottles to a case, in preparation for shipping. Although the exact quantity of the final distilled product (Class IC flammable liquid) that is likely to be stored in this area at any one time is not specifically known, the following represents the likely maximum that would be anticipated:

- 32 wooden barrels @ (approx.) 114 liters [30 gallons]:	3634 liters [960 gallons]
- 6 stainless steel holding tanks @ (approx) 208 liters [55 gallons]:	1248 liters [330 gallons]
- 24 cases of 750 ml bottles @ 4.5 liters [1.2 gallons]:	108 liters [29 gallons]
Total Stored:	**4990 liters [1319 gallons]**

Based on the parameters outlined in the International Building Code (IBC), the brew pub would be generally classified as an "Assembly, A-2", occupancy. If that portion of this facility that will be used for the distillery

operations was to be considered as a separate occupancy, it would be classified as that of a "Factory, F-1, Moderate-hazard" occupancy. It was stated by the owner that the current design plan for this facility is to isolate the area in which the distilling operations are to take place from the remainder of the brew pub by a barrier that has a fire-resistance rating of at least one (1) hour.

The building appears to generally meet the requirements of a Type IIB construction, as defined by the IBC. The exterior walls are all listed as being of masonry construction; nominally 8 inches thick. The floor/ceiling assembly that separates the 1st and 2nd floors consists of a concrete slab that is supported by exposed steel beams and columns. The space that is to be dedicated for the distilling operations is to be installed along a portion of the northwest exterior wall; as shown in Attachment 1 of this report.

Mechanical ventilation is to be installed, just below the ceiling, throughout the brew pub area, including the space to be used for distilling operations. The mechanical systems design drawing indicates that the space to be used for distilling is scheduled to be supplied with approximately 532 cfm of conditioned air. No mechanical exhaust system is scheduled to be provided in this area. Primary access and egress to/from the brew pub is through three personnel doors installed near the northwest, southeast, and southwest corners of the facility. Although the space is currently, not provided with either an installed fire suppression or fire detection/notification system, both are to be added as part of the renovation efforts to accommodate the new brew pub.

Fire / Explosion Hazards

In general, all the individual, constituent materials used to support the distillation and packaging processes do not, by themselves, represent significant fire hazards. The primary fire fuel loading that may be present in the space used for distilling operations may be any empty wood barrels and the cardboard cases that will ultimately be used in storing the finished products.

The final stages of the distillation process are that which represent the greatest potential for a fire/explosion hazard; when the liquid has been distilled and the alcohol content is increased to the point that the beverage becomes a "flammable liquid" and the ethanol (vapor) that is being produced by the distillation (boiling) process could result in the development of an ethanol/air mixture that is within its lower flammability limit (LFL). The still design being used is very basic and employs steam, which is produced in the facility's mechanical room, to generate the heat necessary to boil the liquids. At ambient atmospheric pressure, ethanol will boil at just over 78°C (172°F). Should the boiling rate within the still increase beyond that for with the still was designed, it might result in excessive pressure within the still, causing the relief valve(s) to operate; possibly releasing the ethanol vapor into the space. With an auto-ignition temperature of approximately 426°C (800°F), it is unlikely that the surface temperatures of the still will ever approach the point that it might be expected that contact by an ethanol/air mixture with the still's hot surfaces could result in fire initiation. Other than the electrical systems, no other ignition sources are present within this area.

Due to the alcoholic content, 40% to 60% by volume, of the final products (liquids) being produced by the distillation process, these will primarily be classified as being Class IC flammable liquids, as defined by NFPA 30, the *Flammable and Combustible Liquids Code*. This classification stems from the fact that beverages with alcoholic contents in the range specified above will have flash points between 22.8°C and 37.8°C (73°F and 100°F). Another potential fire hazard that will be associated with the distillery's operation is that of a potential spill of these flammable liquids, such that they, and any vapor that might then be produced, could then be exposed to a potential ignition source. It is reported[1] that the evaporation rate for ethanol at "standard" ambient temperatures of approximately 25°C (77°F) is relatively low, such that even the presence of natural ventilation should be sufficient to prevent the development of an ethanol vapor cloud that would exceed its lower flammability limit. However, if a spill was of significant volume (quantity) or if the area where a spill occurred was subject to "stagnant" air, the potential still exists that the LFL could be achieved. It is beyond the

[1] *Potential Explosion Hazards due to Evaporating Ethanol in Whiskey Distilleries*, HSL/2003/08, H.S. Ledin, Health & Safety Laboratory, Buxton, England.

scope of this evaluation to attempt to determine a specific spill volume(s) that could result in such an occurrence.

The presence of other stored materials, such as the cardboard for the shipping cases and empty wood barrels, will also cause an increase in the overall fire fuel loading (fire potential) within this space. Given that the wood (oak) has a relatively high ignition energy requirement, this represents a very low potential as being an "initial" fire source. The cardboard is much more readily "ignitable", but must still have another ignition source to result in fire initiation.

Research into historical data regarding fires involving distilling facilities indicate that, in general, fires resulting from the distillation processes themselves are extremely rare. Most of the historical data indicates that the greatest risk of fires involving distilled beverages is primarily that resulting when these beverages are exposed to the effects of fires that originated from other sources not directly involving the distillation process. When these (flammable) liquids are exposed to the thermal insult from an adjacent fire, they will begin to rapidly evaporate, potentially producing significant volumes of a flammable vapor. Equally, an adjacent fire can result in the failure of the packaging of the stored liquids, thus resulting in spillage and a significant increase in fire intensity and if sufficient flammable vapors are produced; an explosion.

Review and Assessment of Code & Standards Requirements

The results of this evaluation indicate that the existing national building (IBC) and fire (NFPA) codes do not readily and directly apply to the type and scope of distillery operations that are being proposed for use at this brew pub. However, the requirements of the International Building and Fire Codes (IBC & IFC) (2009 ed.) were used as references in developing recommendations for this project. Other codes that the State of Maine has adopted that are applicable to this project and that were used in the code evaluation for fire and life safety include the latest editions of the National Fire Protection Association's codes; NFPA 30 – *Flammable and Combustible Liquids Code*, NFPA 70 – The *National Electrical Code®*, and NFPA 101 – The *Life Safety Code®*. Additionally, the applicable Factory Mutual (FM) Global Property Loss Prevention Data Sheet, 7-74 – Distilleries, was reviewed and used as a source of information and reference, since much of the fire protection information provided in these sheets is based on historical data specific to that industry.

A primary focus for the review of both the IBC/IFC and NFPA 30 was to ascertain if there would be any limits on the amounts of flammable liquids (Class IC) that could be present / stored within the brew pub space used for the distilling operations. The published limits on the amounts of flammable liquids that can be stored, listed in both of these codes, were specifically exempted for alcoholic beverages that are contained in individual containers that do not exceed 1.3 gallons (5 liters) or wood barrels; refer to para. 9.1.4 of NFPA 30 and para. 3401.2 of the IFC, respectively. It has been indicated that much of the product produced by the still at this brew pub will be stored in either wooden barrels or individual 750 ml (0.2 gal) bottles. As such no specific code limitations exist for the amounts to be stored on site within these containers. However, the codes do not specifically address distilled spirits that are to be temporarily stored within the stainless steel (metal) tanks. As such, if only the requirements for storage of a Class IC flammable liquid are imposed, this would limit the maximum quantity stored, ostensibly in these tanks, to only 240 gallons. However, the manner in which the codes are written would indicate that this is to be the maximum quantity allowed within this (control) area. Given the fact that the product stored in the wooden barrels and glass bottles is not limited, this simply does not make practical sense for this situation. Section 3404.3.4 of the IFC does have specific allowances for the storage of flammable liquids for wholesale and retail sales (Group M) occupancies. Although this facility does not specifically fall into this classification, the protection requirements outlined for this classification do appear to be an appropriate option for developing an acceptable configuration for this facility that will both be practical in supporting the distilling operations, while also ensuring that adequate protective measures are implemented. In general, it appears that when storing the flammable liquids in a sprinklered facility, the code would allow maximum quantities that far exceed that which is anticipated to be stored at any one time in this facility.

NFPA 30 does include specific requirements for "processing facilities" and those that "dispense, handle, transfer, or use" these liquids. The requirements that apply to this facility's operations are primarily to provide a fire detection/notification system and a ventilation system that is designed to prevent the accumulation of flammable vapors; refer to chapters 17 and 18 of NFPA 30. Without specifically performing calculations to ascertain a specific ventilation rate that will prevent the accumulation of flammable vapors, within 25% of the LFL, the code requires that a minimum ventilation rate of 1 cfm/ft^2 be provided. Given the approximate "foot print" of the distilling area, this would require that a ventilation system that can provide approximately 400 cfm be installed. Furthermore, this includes a requirement that the inlet and exhausts for this system be located within 12 inches of the floor and should be installed on opposite sides/ends of the room, such that the air movement will "sweep" vapors from all areas of the space.

The codes also have requirements to ensure that no electrical equipment will be exposed to flammable vapors. In this instance, it will be required that all electrical systems/equipment installed in the distilling area and that are within 3 feet of the floor, meet the requirements of NFPA 70 for a Class I, Division 2 (Zone 2) installation.

As outlined above, many of the requirements in NFPA 30 do not apply to distilled spirits. Although in finished form these liquids are classified as flammable, they would not be considered a "hazardous" material. NFPA 30 does include some requirements with regards to containing and/or controlling spillage from storage containers. The plan for this brew pub includes storage of the finished products in small glass containers, the larger wooden barrels, along with the temporary storage in the steel tanks. The code specifically exempts any need for containment systems for the products stored in the small containers ($\leq$ 5 liters). However, the need to provide containment around the steel tanks and where the barrels are to be stored is less clear. Currently, the facility is not provided with any floor drains that might prevent spillage from leaving the distilling area. It has been stated that liquid transfer from the still will be accomplished using an explosion proof alcohol pump to either the steel tanks or the wooden barrels. With the possible exception of this filling process, the greatest potential for spillage appears to be the possible failure of the glass containers. The wood barrels do not present a high risk of spillage or being accidently ruptured. Once filled, the barrels are not involved in any other process until such time has passed that the contents are ready to be transferred into the smaller containers for distribution/sale, which will also involve the filling process. Any time the products are being transferred to/from the different containers, which represents the highest risk for leakage/spillage, personnel will be present and can quickly take actions to mitigate any spill that might occur. For these reasons, along with the lack of any specific code applicability regarding distilled spirits, it is felt that the only area requiring "containment" would be that area surrounding the steel tanks. It would also be recommended that any containment area provided be of sufficient size to also accommodate the filling process within the containment area.

The actual code requirement for including a fire separation between the distilling area and the remainder of the brew pub area is a bit vague; in light of this specific application. However, it was stated by the owner that they had agreed to provide a 1-hour separation; which coincides with the IBC requirements for separation of an Assembly occupancy from a (low hazard) Factory/Industrial occupancy. However, it is also desired by the owners that the distilling operations be "viewable" by their patrons and the design of the separation wall(s) include the installation of glass viewing windows on two of the interior walls. Given the expense associated with fire-rated glass, coupled with the relatively low hazard nature of the distilled spirits, the use of an alternative approach to providing the adequate separation may be worth consideration. NFPA 101 allows for the use of sprinklers to protect glass installed in the walls of an atrium, where it is often desirous that the building design include the ability to view the atrium from adjacent spaces. Although this application is considerably different from that of an atrium, the basic premise is the same. This, coupled with the low fire hazards associated with the distilling operation and the fact that the spirits are miscible with water and would quickly be diluted below the point at which they would sustain combustion, use of this approach is considered to be an acceptable and safe alternative. If employed, the requirements of Section 8.6.7 (1)(c) of NFPA 101 must be followed; with respect to the window design/installation, along with the spacing of the sprinklers near the windows. Given that, unlike an atrium, a fire hazard exists on both sides of the barrier, it would be

recommended that the sprinklers installed to protect the glass be installed on both sides of the barrier. This configuration should be adequate to provide the necessary protection of the glass to maintain the 1-hour fire separation.

In general, all other pertinent requirements associated with the Life Safety Code® (NFPA 101) are currently being met by the proposed design for the new brew pub.

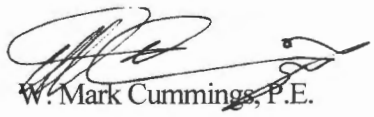
Summary and Recommendations:

The research associated with this fire hazard assessment indicates that, in general, fires resulting directly from distillery operations are rare. However, should a fire occur that ultimately exposes/involves the distilled products (flammable liquids), the results could be severe. Based on this assessment and the historical data reviewed, it is likely that the other areas within the brew pub, such as the kitchen and dining areas, likely represent a greater risk of fire than does the actual distilling operations. This is based on the fact that the distilling operations will only occur while the area is manned, such that any problem that might occur during these operations would be immediately identified and corrective measures implemented. However, this is not meant to imply that the operation of this distillery is not without inherent fire risks. Equally, it is recommended that specific measures be implemented to further mitigate the potential for damage to the building and the operation of the adjacent tenants, along with complying with all pertinent code requirements.

Based on the results of this assessment, the following recommendations are provided:

1. Incorporate the use of a containment "berm" that surrounds the areas where the still and stainless steel tanks, are to be installed, along with providing additional area within the containment berm to allow filling operations within this containment area.
2. Ensure that any electrical systems/equipment that is to be installed within the distilling area and that is within three (3) feet of the floor meet the requirements for a Class I, Division 2 (Zone 2) installation, as outlined by NFPA 70.
3. Consider a modification to the current supply ventilation ducting in the distilling area that would allow supply air to be provided at a level within 12 inches of the floor. An exhaust system needs to be added to this area; with the inlet within 12 inches of the floor and at a location that is opposite from the supply. An air flow rate (inlet and exhaust) of at least 400 cfm should be provided, but as a minimum, the exhaust rate must be equal to or greater than the supply rate to ensure that the area is not under "positive" pressure. This to prevent any vapors from exiting the distilling area.
4. If the sprinkler-protected glass option is to be used as part of the fire separation scheme to isolate the distilling area, ensure that all requirements within Section 8.6.7(1)(c) are adhered to.
5. To ensure that adequate fire protection is provided in light of the maximum quantities of flammable liquids (distilled spirits) that may be stored within the distilling area, it is recommended that the sprinkler system be designed to provide a water density that is commensurate with protection of an Ordinary Hazard, Group 2 occupancy classification, as outlined in NFPA 13, *The Standard for the Installation of Sprinkler Systems*.

Should there be any questions regarding this assessment and the recommendations contained herein, please do not hesitate to contact me.



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